# Heat-Trace Panels

CONNECT AND PROTECT

This section provides an overview and general design guidelines for nVent RAYCHEM heat-tracing power distribution panels. For complete design assistance, contact your nVent representative or visit our website at nVent.com/RAYCHEM.

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## INTRODUCTION

HTPG and HTPI panels are a cost-effective and convenient means of providing ground-fault protection to heat-tracing circuits.

nVent offers two types of heat-trace panels: the nVent RAYCHEM brand HTPG (Heat-Tracing Panel Group Control) and HTPI (Heat-Tracing Panel Individual Control). These distribution panels have the option of using ground-fault circuit breakers (30-mA trip level). Per national electrical codes and nVent requirements, ground-fault protection must be provided for each heat-tracing circuit. The HTPG and HTPI panels are a cost-effective and convenient means to provide this protection. nVent also supplies specialty panels for specific project requirements. Contact your nVent representative for additional information.

Fig. 1 represents a typical heat-tracing power distribution system. At the Motor Control Center (MCC) the voltage is reduced to the level required for the heat tracing. The transformer supplies this reduced voltage to the distribution panelboard, which contains the main circuit breaker and branch circuit breakers. From the branch circuit breakers (CB), the voltage is transferred to the heater's power connection box via wire/conduit or cable. This section will assist you in sizing and specifying the transformer and heat-tracing panel.

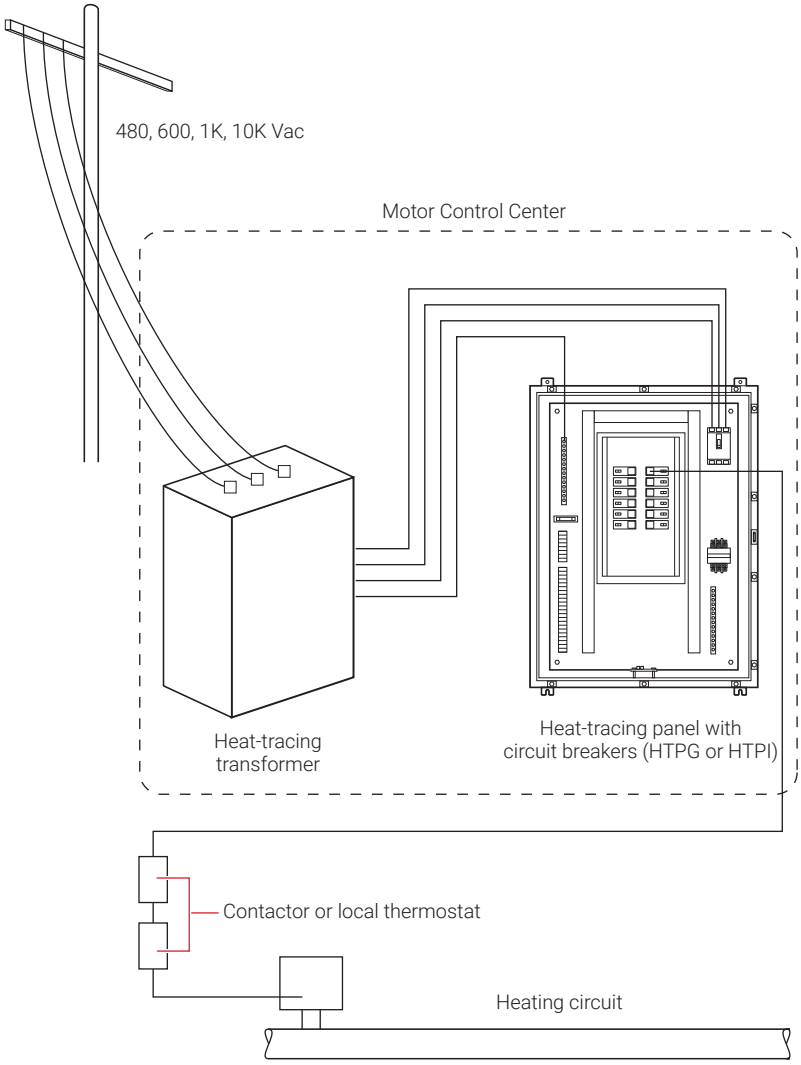



**Fig.1 Typical heat-tracing power distribution system**

## Heat-Trace Panels — Group Control

### nVent RAYCHEM HTPG

The HTPG is a dedicated power distribution, control, ground-fault protection, monitoring, and alarm panel. This system is used for freeze protection control, broadband maintenance temperature control, or applications in which multiple circuits (branch circuit breakers) are energized at one time.

A typical HTPG panel includes a wall-mounted enclosure, assembled panelboard, main contactor, main circuit breaker, Hand/Off/Auto switch, contactor-energize light, and door disconnect handle.

Fig. 2 shows a typical HTPG panel layout. This wall-mounted enclosure contains an assembled panelboard, main contactor, main circuit breaker, Hand/Off/Auto switch, and contactor-energize light. The panel has options for terminal blocks, alarm relay (form C contacts), common alarm light, door disconnect handle, and alarm horn.

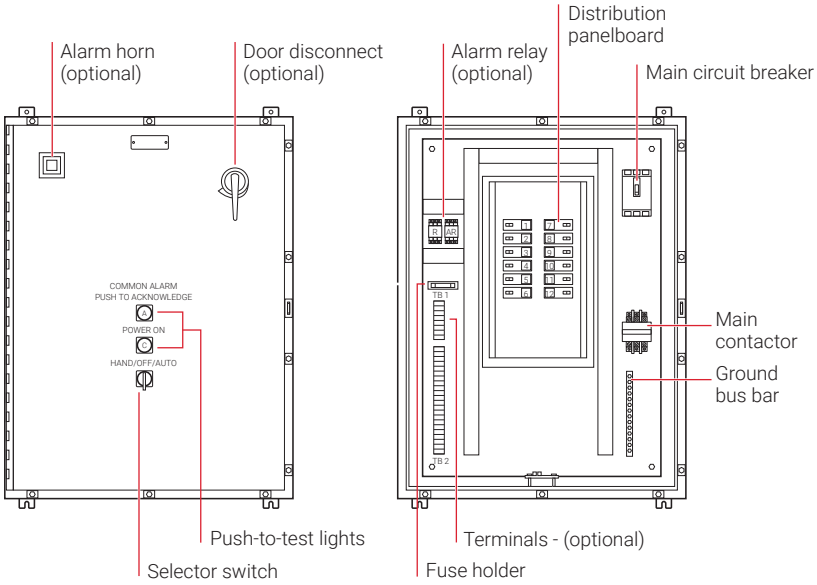
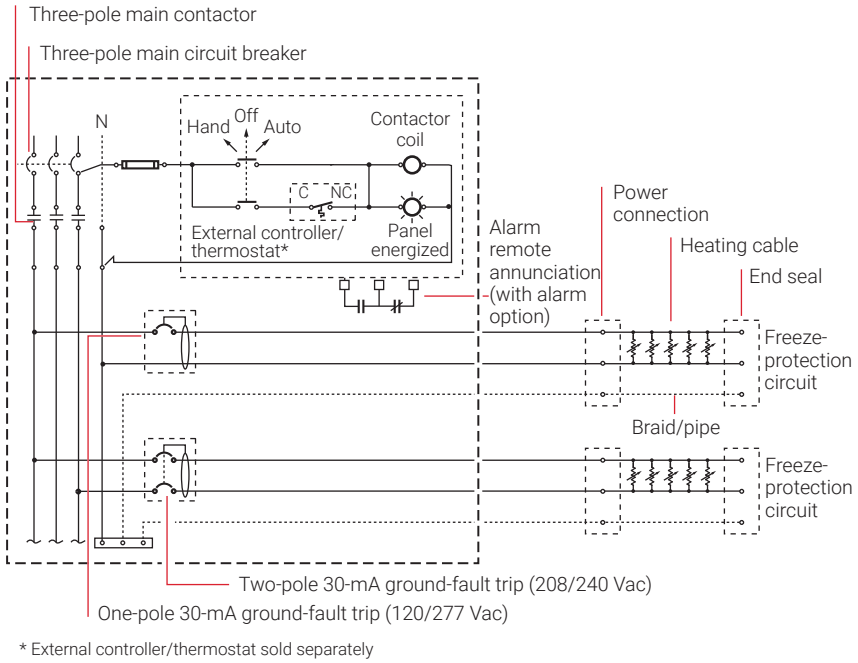



**Fig. 2 Typical HTPG panel layout**

Fig. 3 depicts a typical HTPG schematic. The device that energizes the main contactor can be an ambient sensing thermostat (mounted remotely), an electronic controller, a snow sensor controller, or any device with a contact that changes state when the heat tracing is energized.




* External controller/thermostat sold separately

**Fig. 3 Typical HTPG schematic**

A typical HTPI panel includes a wall-mounted enclosure, assembled panelboard, main circuit breaker, and door disconnect handle.

## nVent RAYCHEM HTPI

The HTPI is a dedicated power distribution, ground-fault protection, monitoring, and alarm panel. This system is used with a line sensing thermostat (mounted remotely) or a line sensing electronic controller to give individual line sensing control.

Fig. 4 shows a typical panel layout of an HTPI. This wall-mounted enclosure contains an assembled panelboard and main circuit breaker. The panel has options for terminal blocks, alarm relay (form C contacts), common alarm light, door disconnect handle, and alarm horn. Fig. 5 depicts a typical HTPI schematic.

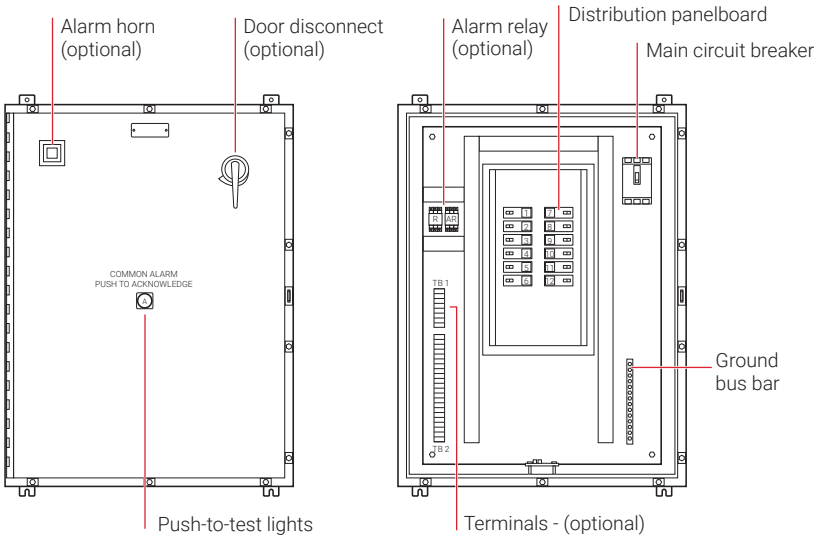



**Fig. 4 Typical HTPI panel layout**

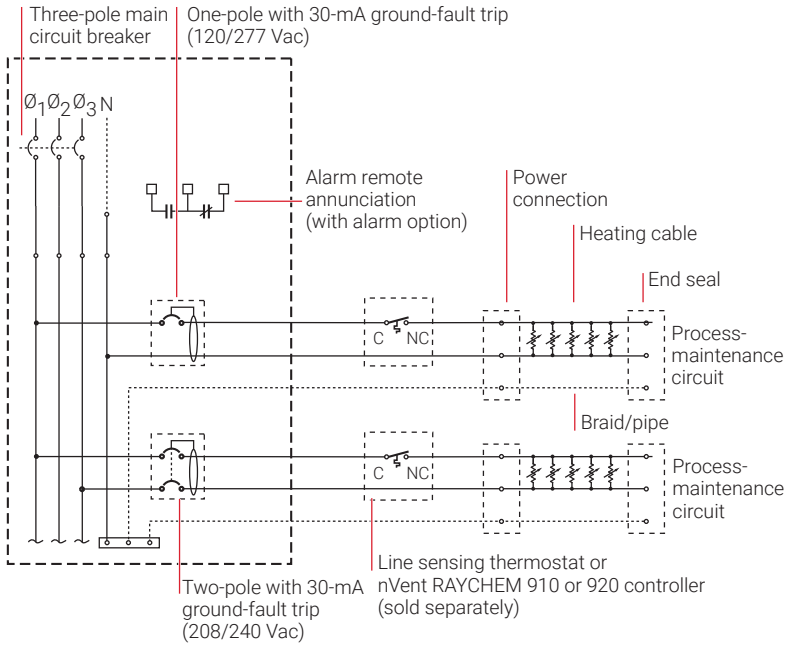



**Fig. 5 Typical HTPI schematic**

## APPROVALS AND CERTIFICATIONS

The HTPG and HTPI heat-trace panels are built to UL 508A guidelines and labeled accordingly. The UL508A control panel label is a certification that all assembly, wiring, and testing was done in strict accordance with UL guidelines. Control panel manufacturers must complete an extensive review process of their procedures and demonstrate an understanding of electrical systems, code requirements, and various safety issues in order to qualify as an ETL Listed panel shop. They are subsequently reviewed on a quarterly basis to ensure that all finished products utilize UL-marked components and are manufactured to all UL standards. Assembly and testing of all panels is done in a ETL Certified facility. All panels are functionally tested before shipment. Other applicable standards include UL 67 for panelboards, UL 50 for cabinets, National Electrical Code, NEMA Standards PB1, and Federal Inspection W-P-115C.

ETL LISTED
CONFORMS TO
ANSI/UL STD. 508
UL STD. 508A
CERTIFIED TO
CAN/CSA C22.2 NO. 14

Intertek
9700701

Intertek

## DRAWINGS

For each panel configuration, a set of drawings (BOM and schematic) is created. These drawings are sent to the purchaser for approval or for information only (panel released at time of order). The drawings are 11" x 17" (B size).

## PANEL DESIGN FOR THREE-PHASE SYSTEMS

### Overview

The panel design process involves four steps:

1. Gather the necessary information.
   - Total start-up circuit breaker (CB) amps
   - KVA rating of the transformer
   - Phase-to-neutral voltage of the transformer secondary ($V_{p-n}$)
   - Phase-to-phase voltage of the transformer secondary ($V_{p-p}$)
2. Determine main circuit breaker and transformer size.
3. Select the panelboard.
4. Select the ground-fault circuit breaker.

### Panel Design

| Panel Design |
|---|
| 1. Gather information |
| 2. Determine main circuit breaker and transformer size |
| 3. Select panelboard |
| 4. Select ground-fault circuit breaker |

#### Step 1 Gather the necessary information

To begin your panel design, gather and record the following information:

- Total start-up CB Amps.....
- KVA rating of the transformer.....
- Phase-to-neutral voltage of the transformer secondary ($V_{p-n}$).....
- Phase-to-phase voltage of the transformer secondary ($V_{p-p}$).....

**Note:** Start-up Amps may be obtained by using TraceCalc Pro design software or by contacting your nVent representative.

| Panel Design |
|---|
| 1. Gather information |
| 2. Determine main circuit breaker and transformer size |
| 3. Select panelboard |
| 4. Select ground-fault circuit breaker |

## Step 2 Determine main circuit breaker and transformer size

### Main Breaker Sizing

The purpose of the main circuit breaker is to protect the transformer, and the wiring between the transformer and, the panelboard, and the panelboard bussing. The main breaker also provides a way to disconnect power to the panelboard for maintenance purposes. Table 1 on page 7, shows the maximum size main circuit breaker that can be used with each size transformer. Choose the appropriate main circuit breaker based upon your application.

### Transformer Sizing

Transformers must be sized for the start-up load. This ensures that the main breaker, which protects the transformer, is large enough to take the start-up currents produced by heaters that have transient currents, such as self-regulating heaters. For most applications, this is based on the total start-up current. The formula for calculating minimum transformer rating is:

$$\frac{V_{p\text{-}p} \times I_T \times SF \times 1.73}{1000} = KVA$$

Where:

| | | |
|---|---|---|
| KVA | = | KVA rating of the transformer |
| SF | = | Safety factor (allowance for spare capacity) |
| $I_T$ | = | Total start-up current |
| $V_{p\text{-}p}$ | = | Phase-to-phase voltage of the transformer secondary |

After you have applied the above formula, go to Table 1 and choose the next largest standard transformer.

**Note:** The above formula are based upon the assumption that the transformer is perfectly balanced and the entire panelboard will be energized at the same minimum ambient temperature for which the branch circuit breakers were sized.

## TABLE 1 MAXIMUM THREE-PHASE MAIN CIRCUIT BREAKER SIZING

| Trans. size (KVA) | Maximum primary main circuit breaker size | | | | Maximum secondary main circuit breaker size | | | |
|---|---|---|---|---|---|---|---|---|
| | 600 V | | 480 V | | 120/208 V | | 277 V | |
| | Calculated CB size | | Calculated CB size | | Calculated CB size | | Calculated CB size | |
| 3 | 3.6 | 4-F | 4.5 | 6-F | 10.4 | 15 | 4.5 | 6-F |
| 6 | 7.2 | 9-F | 9.0 | 15 | 20.8 | 30 | 9.0 | 15 |
| 9 | 10.8 | 15 | 13.5 | 15 | 31.3 | 40 | 13.5 | 15 |
| 15 | 18.0 | 20 | 22.6 | 30 | 52.1 | 60 | 22.6 | 30 |
| 30 | 36.1 | 40 | 45.1 | 50 | 104.2 | 125 | 45.1 | 50 |
| 45 | 54.1 | 60 | 67.7 | 70 | 156.3 | 175 | 67.7 | 70 |
| 75 | 90.2 | 100 | 112.8 | 125 | 260.4 | 300 | 112.8 | 125 |
| 112.5 | 135.3 | 150 | 169.1 | 175 | 390.6 | 400 | 169.2 | 175 |
| 150 | 180.4 | 200 | 225.5 | 225 | 520.8 | 600 | 225.6 | 225 |
| 225 | 270.6 | 300 | 338.3 | 400 | 781.3 | 800 | 338.4 | 400 |
| 300 | 360.8 | 400 | 451.1 | 500 | 1041.7 | 1200 | 451.3 | 500 |

## TABLE 2 MAXIMUM SINGLE-PHASE MAIN CIRCUIT BREAKER SIZING

| Trans. size (KVA) | Maximum primary main circuit breaker size | | | | Maximum primary main circuit breaker size | |
|---|---|---|---|---|---|---|
| | 600 V | | 480 V | | 120/240 V | |
| | Calculated CB size | | Calculated CB size | | Calculated CB size | |
| 3 | 6.3 | 9-F | 7.8 | 9-F | 15.6 | 20 |
| 5 | 10.4 | 15 | 13.0 | 15 | 26.0 | 30 |
| 7.5 | 15.6 | 20 | 19.5 | 20 | 39.1 | 40 |
| 10 | 20.8 | 30 | 26.0 | 30 | 52.1 | 60 |
| 15 | 31.3 | 40 | 39.1 | 40 | 78.1 | 80 |
| 25 | 52.1 | 60 | 65.1 | 70 | 130.2 | 150 |
| 37.5 | 78.1 | 80 | 97.7 | 100 | 195.3 | 200 |
| 50 | 104.2 | 125 | 130.2 | 150 | 260.4 | 300 |
| 75 | 156.3 | 175 | 195.3 | 200 | 390.6 | 400 |

| Panel Design |
|---|
| 1. Gather information |
| 2. Determine main circuit breaker and transformer size |
| 3. Select panelboard |
| 4. Select ground-fault circuit breaker |

### Step 3 Select the panelboard

The standard bus ratings (amperage/phase) for panelboards are 100 A, 225 A, and 400 A. The higher the bus rating, the more expensive the panelboard. Where possible, it is most cost-effective to limit the main circuit breaker and bus rating to 225 A. As mentioned, the main circuit breaker must protect the bussing in the panelboard. Therefore, your main circuit breaker will determine your panelboard bus rating.

| Panel Design |
|---|
| 1. Gather information |
| 2. Determine main circuit breaker and transformer size |
| 3. Select panelboard |
| 4. Select ground-fault circuit breaker |

## Step 4 Select ground-fault circuit breaker

The number of spaces taken by GFCBs is a function of the voltage. Table 3 lists the number of spaces each breaker takes in a panelboard, as well as the number of connections to a panelboard.

### TABLE 3 GFCB PANELBOARD REQUIREMENT

| Voltage | Number of spaces per GFCB |
|---|---|
| 120 | 1 |
| 208/240 | 2 |
| 277 | 2 |

### Alarm Options

We offer optional relay alarm breakers for the HTPI and HTPG heat trace panels. The relay alarm uses standard ground-fault circuit breakers wired to a relay. Upon a ground fault / trip condition or if / when the breaker is turned off, the relay changes state (closes) sending a signal to the common alarm relay provided in the panel that the breaker has tripped or has been turned to the “Off” position. Once in alarm, turning the breaker to the “On” position or removing the relay will clear the alarm (see Fig. 7).

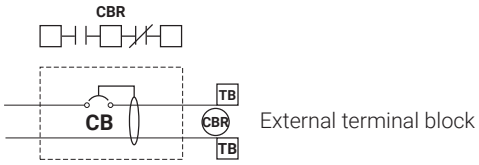



**Fig. 6 Ground-fault circuit breaker with external relay for alarm Buried piping**


RAYCHEM-DG-H56890-HeatTracePowerDistributionPanels-EN-2212

## HTPG Overview

The HTPG selection process involves two steps:

1. Gather the necessary information:
   - Voltage
   - Panelboard size
   - Circuit breaker type and rating
   - Number of circuit breakers (availability per voltage)
   - Type of enclosure
   - Main circuit breaker and contactor
   - Options
2. Assemble the catalog number.

## HTPG Catalog Number

HTPG comes in a variety of configurations. The following chart outlines the elements that constitute a configuration and the corresponding catalog number.

**HTPG - Voltage - Panelboard - C.B. type - # of C.B./# of poles (rating) - Enclosure - MCB - Options**

**HTPG - 277/480 - 30 - 2 - 14/1P (30) - 4X - 200 - H**

**Voltage**
120/208 120/240* 277/480

**Panelboard size**
18 = 18 space panelboard (277 V only)
30 = 30 space panelboard
42 = 42 space panelboard
54 = 54 space panelboard (277 V only)

**Circuit breaker type**
2 = GFCB (30-mA trip) without alarm
4 = GFCB (30-mA trip) with relay alarm (includes terminal block option).

**Number of circuit breakers/number of poles (circuit breaker rating) see prior page**
# of breakers

| | 120 V (1P) | 208 V (2P) | 240 V (2P) | 277 V (1P) |
|---|---|---|---|---|
| 18 | (1–18) | (1–8) | (1–8) | (1–8) |
| 30 | (1–30) | (1–14) | (1–14) | (1–14) |
| 42 | (1–42) | (1–20) | (1–20) | (1–20) |
| 54 | – | – | – | (1–26) |

**Option**
0 = None
A = Alarm horn (requires C.B. type 4)
B = Alarm beacon (requires C.B. type 4)
C = Heat-trace contactor failure light
D = Door disconnect
E = Environmental purge (TYPE 4 or 4X enclosures only)
G = Panel power-on light
H = Space heater and thermostat
L = Individual circuit breaker trip indication lights (requires C.B. type 4)
P = Heat-trace energized light
T = Terminal blocks (prewired)
W = Wired for ETI controller
Z = Z-purge system (TYPE 4 or 4X enclosures only)
SP = Special requirement: Must contain complete description of variance

**MCB**

**Main circuit breaker and contactor**

| Panelboard size | 120/208 | 120/240 | 277/480 |
|---|---|---|---|
| 18 | 50, 100 | 50, 100 | 30, 50, 70, 125 |
| 30 | 50, 100, 150, 200, 225 | 50, 60, 80, 150, 175, 200, 225 | 50, 70, 125, 175, 225 |
| 42 | 50, 100, 150, 200, 225 | 50, 60, 80, 150, 175, 200, 225 | 50, 70, 125, 175, 225 |
| 54 | – | – | 50, 70, 125, 175, 225 |

**Enclosure**
12 = TYPE 12 (indoors)
4 = TYPE 4 (outdoors)
4X = TYPE 4X (stainless steel–outdoors)

* Single phase

**Fig. 7 HTPG catalog number elements**

### Voltage

This is the voltage at which the heater is powered. If you have a combination of 120 V and 208 V heaters in the same panelboard, use 120 / 208 as the voltage. For 240 V, we are assuming that the voltage to the panelboard is single-phase (two phases and a neutral).

### Panelboard size

Specify the panelboard size you will require based on the number and type of circuit breakers required. You can specify a larger-than-required panelboard for spare space.

### Circuit breaker type and rating

Specify the type of ground-fault breakers you require in the panelboard. In the parenthesis, fill in the amperage of the breakers (refer to Fig. 7). If more than one amperage is required, then list all the amperages; for example, 3/2P(50), 4/2P(40).

### Number of breakers

Fig. 7 lists the standard numbers of breakers we offer in a single panelboard.
If you require more or fewer than the number of breakers shown, list the actual number of breakers required and we can provide a factory quote.

### Enclosure

Fig. 7 shows the standard enclosures. If the panel will be located in a hazardous location (CID2), specify NEMA Type 4 or 4X enclosure for a Z-purge system and choose Z (Z purged) option.

### MCB / contactor

If you require a main circuit breaker less than 100 A, state the required amperage. If you require a main circuit breaker larger than 225 A, state the required amperage and we can provide a factory quote.

## HTPG Selection Process

| HTPG Selection |
|---|
| 1. Gather information |
| 2. Assemble catalog number |

### Step 1 Gather the necessary information

Gather and record the following information:

- Voltage.....
- Panelboard size .....
- Circuit breaker type and rating .....
- Number of circuit breakers (availability per voltage).....
- Type of enclosure .....
- MCB/contactor .....
- Options .....

**Example: Information on sample application**

| | |
|---|---|
| Voltage | 277 |
| Panelboard size | 30 |
| Circuit breaker type and rating | 30 A without alarm |
| Number of breakers | 14 |
| Type of enclosure | NEMA Type 4X |
| MCB/contactor | 200 A MCB/contactors |
| Options | Space heater with thermostat |

| HTPG Selection |
|---|
| 1. Gather information |
| 2. Assemble catalog number |

## Step 2 Assemble the catalog number

**Example: HTPG-277/480-30-2-14/1P(30)-4X-200-H**

### HTPI Overview

The HTPI selection process involves two steps:

1. Gather the necessary information:
   - Voltage
   - Panelboard size
   - Circuit breaker type and rating
   - Number of circuit breakers (availability per voltage)
   - Type of enclosure
   - MCB
   - Options
2. Determine configuration and the corresponding catalog number.

### HTPI Catalog Number

HTPI comes in a variety of configurations. The following chart outlines the elements that constitute a configuration and the corresponding catalog number.

**HTPI - Voltage - Panelboard - C.B. type - # of C.B./# of poles (rating) - Enclosure - MCB - Options**

**HTPI - 277/480 - 30 - 2 - 10/1P (20) - 4X - 200 - H**

**Voltage**
120/208 120/240* 277/480

Panelboard size
18 = 18 space panelboard
30 = 30 space panelboard
42 = 42 space panelboard
54 = 54 space panelboard (277 V only)

**Circuit breaker type**
1 = Overcurrent circuit breakers**
2 = GFCB (30-mA trip) without alarm
4 = GFCB (30-mA trip) with relay alarm (includes terminal block option).

**Number of circuit breakers/number of poles (circuit breaker rating) see prior page**
# of breakers

| | 120 V (1P) | 208 V (2P) | 240 V (2P) | 277 V (1P) | 277 V** (std. C.B.) (1P) |
|---|---|---|---|---|---|
| 18 | (1–18) | (1–8) | (1–8) | (1–7) | (1–17) |
| 30 | (1–29) | (1–14) | (1–14) | (1–13) | (1–29) |
| 42 | (1–41) | (1–20) | (1–20) | (1–19) | (1–41) |
| 54 | – | – | – | (1–25) | – |

Option
0 = None
A = Alarm horn (requires C.B. type 4)
B = Alarm beacon (requires C.B. type 4)
D = Door disconnect
E = Environmental purge (TYPE 4 or 4X enclosures only)
G = Panel power-on light
H = Space heater and thermostat
L = Individual circuit breaker trip indication lights (requires C.B. type 4)
T = Terminal blocks (prewired)
Z = Z-purge system (TYPE 4 or 4X enclosures only)
SP = Special requirement: Must contain complete description of variance

**MCB**

**Main circuit breaker size or MLO for no main breaker**

| Panelboard size | 120/208 | 120/240 | 277/480 |
|---|---|---|---|
| 18 | 50, 100 | 50, 100 | 30, 50, 70, 125 |
| 30 | 50, 100, 150, 200, 225 | 50, 60, 80, 150, 175, 200, 225 | 50, 70, 125, 175, 225 |
| 42 | 50, 100, 150, 200, 225 | 50, 60, 80, 150, 175, 200, 225 | 50, 70, 125, 175, 225 |
| 54 | – | – | 50, 70, 125, 175, 225 |

Enclosure
1 = TYPE 1 (indoors)
12 = TYPE 12 (indoors)
4 = TYPE 4 (outdoors)
4X = TYPE 4X (stainless steel–outdoors)

* Single phase
** Overcurrent circuit breakers require ground-fault protection from controller

**Fig. 8 HTPI catalog number elements**

### Voltage

This is the voltage at which the heater is powered. If you have a combination of 120 V and 208 V heaters in the same panelboard, use 120 / 208 as the voltage.
For 240 V, we are assuming that the voltage to the panelboard is single-phase (two phases and a neutral).

### Panelboard size

Specify the panelboard size you will require based on the number and type of circuit breakers required. You can specify a larger-than-required panelboard for spare space.

### Circuit breaker type and rating

Specify the type of breakers you require in the panelboard. If you choose a standard circuit breaker, the ground-fault protection function must come from the controller. In the parenthesis ( ), fill in the amperage of the breakers (refer to Fig. 8). If more than one amperage is required, then list all the amperages; for example, 3/2P(50), 4/2P(40).

### Number of breakers

Fig. 8 lists the standard numbers of breakers we offer in a single panelboard.
If you require more or fewer than the number of breakers shown, list the actual number of breakers required and we can provide a factory quote.

### Enclosure

Fig. 8 shows the standard enclosures. If the panel will be located in a hazardous location (CID2), specify NEMA Type 4 or 4X enclosure for a Z-purge enclosure and choose Z (Z purged) option.

### MCB

If you require a main circuit breaker less than 100 A, state the required amperage. If you require a main circuit breaker larger than 225 A, state the required amperage and we can provide a factory quote.

## HTPI Selection Process

| HTPI Selection |
|---|
| 1. Gather information |
| 2. Assemble catalog number |

### Step 1 Gather the necessary information

Gather and record the following information:

- Voltage.....
- Panelboard size .....
- Circuit breaker type and rating .....
- Number of circuit breakers (availability per voltage).....
- Type of enclosure.....
- Type of main circuit breaker.....
- Options .....

**Example: Information on sample application**

| | |
|---|---|
| Voltage | 277 |
| Panelboard size | 30 |
| Circuit breaker type and rating | 20 A without alarm |
| Number of breakers | 10 |
| Type of enclosure | NEMA Type 4X |
| Type of main circuit breaker | 200 A main circuit breaker |
| Options | Space heater with thermostat |

| HTPI Selection |
|---|
| 1. Gather information |
| 2. Assemble catalog number |

### Step 2 Assemble the catalog number

**Example: HTPI-277/480-30-2-10/1P(20)-4X-200-H**

**North America**
Tel +1.800.545.6258
Fax +1.800.527.5703
info@nVent.com

**Latin America**
Tel +1.713.868.4800
Fax +1.713.868.2333
thermal.info@nVent.com

Our powerful portfolio of brands:
CADDY ERICO HOFFMAN RAYCHEM SCHROFF TRACER



RAYCHEM-DG-H56890-HeatTracePowerDistributionPanels-EN-2212